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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/053,300	01/17/2002	Vishnu K. Agarwal	303.780US1	5007

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EXAMINER

PHAM, HOAI V

ART UNIT PAPER NUMBER

2814

DATE MAILED: 05/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/053,300

Applicant(s)

AGARWAL ET AL.

Examiner

Hoai V Pham

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 March 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 and 58-77 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-28 and 58-77 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 1-28 and 58-77 in Paper No. 3 is acknowledged.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the transistor must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.
3. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
5. Claims 16 and 17-28, 58-77 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 16, "a third layer about the process stack" renders the claim indefinite. It is not clear how "a third layer about the process stack" define the claim structure.

What does "a third layer about the process stack" mean? Where is "a third layer about the process stack" located?

Claims 17 and 24, line 5, "a process stack extending away from the surface" renders the claim indefinite. It is not clear how "a process stack" extending away from the surface of the substrate.

Claim 28, 58, 64, 72, and 75, "a transistor on the substrate, the transistor being formed from a process stack having" renders the claim indefinite because:

- It is not clear how the transistor can be formed by a process stack while the specification pages 6-9 shows that the process stack is used to form the trench isolation.
- The oxide layer and the nitride layer have been removed before forming the transistor thus there is no oxide and nitride layers left in the final structure (see fig. 6B, pages 9-10).

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-3, 5-7, 9, 12-15, 28 are rejected under 35 U.S.C. 102(b) as being anticipated by Furukawa et al. [U.S. Pat. 5,798,553].

With respect to claims 1, 6, 9, and 15, Furukawa et al. (figs. 2A-2G, cols. 3-7) discloses an apparatus, comprising:

- a substrate (10) having at least one trench wall (26A, 26B);

- a first layer (14);

- a second layer (14) (see col. 4, lines 1-3) wherein the first layer, the second layer and a portion of the substrate form a process stack, the first and second layers being a pull back distance from the trench wall thereby forming an implant region having a migration region; and

- a dopant in the implant region and migration regions (see fig. 2G).

Furukawa et al. discloses the same structure of applicant invention. Therefore, those skilled in the art would recognize that a central area underneath the first layer having a threshold voltage that is about substantially uniform.

With respect to claim 2, Furukawa et al. discloses that the pull back distance is in a range from about 25 Å to about 300 Å (see fig. 2F, col. 6, lines 14-15).

With respect to claim 3, Furukawa et al. discloses that the pull back distance is substantially symmetrical about the second layer.

With respect to claims 5 and 13, Furukawa et al. discloses that the dopant has an implant energy in a preferred implant energy range from about 5 to about 25 keV (see col. 7, lines 10-15).

With respect to claim 7, Furukawa et al. discloses the same structure of applicant invention. Therefore, those skilled in the art would recognize that the dopant in the implant region changes an electrical characteristic of the implant region thereby making

a threshold voltage in the implant region about equivalent to or greater than a threshold voltage in the central area of the substrate underneath the first layer.

With respect to claim 12, Furukawa et al. discloses that the dopant is one of Boron (see col. 7, lines 10-14).

With respect to claim 14, Furukawa et al. discloses that the implant energy is in a more preferred implant energy range of less than or equal to about 10 keV (see col. 7, lines 10-15).

8. Claims 1, 3, 6-7, 9, 10, 15, 17, 19, and 22-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Oh et al. [U.S. Pat. H204].

With respect to claims 1, 6, 9, 15, and 17, Oh et al. (figs. 2-10, cols. 2-5) discloses an apparatus, comprising:

- a substrate (30) having at least one trench wall (54, 56) (see fig. 7);

- a first layer (32, oxide);

- a second layer (34, nitride) wherein the first layer, the second layer and a portion of the substrate form a process stack, the first and second layers being a pull back distance from the trench wall thereby forming an implant region (62, 64); and

- a dopant in the implant region (see fig. 7).

Oh et al. discloses the same structure of applicant invention. Therefore, those skilled in the art would recognize that a central area underneath the first layer having a threshold voltage that is about substantially uniform.

With respect to claim 3, Oh et al. discloses that the pull back distance is substantially symmetrical about the second layer (see fig. 7).

With respect to claim 7, Oh et al. discloses the same structure of applicant invention. Therefore, those skilled in the art would recognize that the dopant in the implant region changes an electrical characteristic of the implant region thereby making a threshold voltage in the implant region about equivalent to or greater than a threshold voltage in the central area of the substrate underneath the first layer.

With respect to claim 10, Oh et al. discloses that the substrate is a P-type substrate and the dopant is a P-type dopant (see col. 2, line 46 and col. 3, lines 43-46).

With respect to claim 12, Oh et al. discloses that the dopant is one of Boron (see col. 3, lines 43-46).

With respect to claim 19, Oh et al. discloses that the dopant (62, 64) is present in the substrate at the at least one trench wall (see fig. 7).

With respect to claims 22-23, Oh et al. discloses that the implant region occupies a migration region adjacent to the oxide layer (see fig. 7).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. [U.S. Pat. 5,798,553].

Furukawa et al. does not teach the exact concentration, as claimed by Applicant. However, the concentration range would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

12. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. [U.S. Pat. 5,798,553] as applied to claims 6-7 above, and further in view of Parekh et al. [U.S. Pat. 5,945,724].

Furukawa et al. discloses all the limitation as claimed above except: the substrate further includes a corner region having a rounded contour. However, Parekh et al. discloses that the substrate includes a corner region (31a, 31b) having a rounded

contour (see fig. 3, col. 7, lines 1-19). Therefore, it would have been obvious to one having skill in the art at the time the invention was made to have the substrate having a rounded corner as taught by Parekh et al. into the device of Furukawa et al. in order to prevent leakage current and to provide better filling material in the trench while reducing the critical dimension for the trench width.

13. Claims 2, 4, 5, 11, 13, 14, and 18, are rejected under 35 U.S.C. 103(a) as being unpatentable over Oh et al. [U.S. Pat. H204].

With respect to claims 2, 4, 5, 13, 14, and 18, Oh et al. does not teach the exact pull back distance, a concentration, an implant energy, as claimed by Applicant. However, the pull back distance, the concentration, the implant energy range would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

With respect to claim 11, Oh et al. does not disclose an N-type substrate and an N-type dopant. However, It will be apparent to those skilled in the art that the opposite conductivity types can be substituted for the substrate and the dopant.

14. Claims 8, 20, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oh et al. [U.S. Pat. H204] as applied to claims 6-7 above, and further in view of Parekh et al. [U.S. Pat. 5,945,724].

Oh et al. discloses all the limitation as claimed above except: the at least one trench wall is angled in relation to the surface and the substrate includes a corner region having a rounded contour. However, Parekh et al. discloses that the at least one trench wall is angled in relation to the surface and the substrate includes a corner region (31a, 31b) having a rounded contour (see fig. 3, col. 6, lines 16-30 and col. 7, lines 1-19). Therefore, it would have been obvious to one having skill in the art at the time the invention was made to have the at least one trench wall is angled in relation to the surface and the substrate includes a corner region (31a, 31b) having a rounded contour, as taught by Parekh et al., into the device of Oh et al. in order to prevent leakage current and to provide better filling material in the trench while reducing the critical dimension for the trench width.

15. Claims 24-27, as best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. [U.S. Pat. 5,798,553] in view of Oh et al. [U.S. Pat. H204].

With respect to claims 24 and 27, Furukawa et al. (figs. 2A-2G, cols. 3-7) discloses an apparatus having reduced transistor leakage attributes, comprising:

a substrate (10) having a surface, a corner region and at least one trench wall (26A, 26B) (see fig. 2E);

a stack layer (14) and a portion of the substrate form a process stack formed on the surface, the stack layer (14) being a pull back distance in a range from about 25 A to about 300 A from the trench wall thereby forming an implant region, the pull back

distance being substantially symmetrical about the stack layer (14), the corner region of the substrate comprising a part of the implant region; and

a dopant in the implant region thereby changing an electrical characteristic of the implant region and making a threshold voltage in the corner region about equivalent to or greater than a threshold voltage in a central area of the substrate underneath the oxide layer, the threshold voltage of the central area of the substrate being about substantially uniform.

Furukawa et al. discloses that the stack layer (14) can be used various other layer or combinations of layers (see col. 4, lines 51-55). Furukawa et al. does not disclose that the stack layer (14) comprises an oxide layer and a nitride layer on the oxide layer. However, Oh et al. discloses that an oxide layer (32) and a nitride layer (34) on the oxide layer and their uses are well known in the art for forming the stack layer (see fig. 2, col. 3, lines 23-28). Therefore, it would have been obvious to one having skill in the art at the time the invention was made to select oxide and nitride as known materials, as taught by Oh et al. into the device of Furukawa et al. in order to use as a mask for etching the trench in the substrate. Moreover, selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

With respect to claim 25, Furukawa et al. discloses that the dopant is one of Boron (see col. 7, lines 10-15).

16. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. [U.S. Pat. 5,798,553] and Oh et al. [U.S. Pat. H204] as applied to claims 24-25 above, and further in view of Parekh et al. [U.S. Pat. 5,945,724].

Furukawa et al. and Oh et al. disclose all the limitation as claimed above except: the corner region having a rounded contour. However, Parekh et al. discloses that the corner region (31a, 31b) having a rounded contour (see fig. 3, col. 7, lines 1-19). Therefore, it would have been obvious to one having skill in the art at the time the invention was made to have the rounded corner as taught by Parekh et al. into the device of Furukawa et al. in order to prevent leakage current and to provide better filling material in the trench while reducing the critical dimension for the trench width.

17. Claim 28, as best understood, is rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. [U.S. Pat. 5,798,553] in view of Parekh et al. [U.S. Pat. 5,945,724].

Furukawa et al. (figs. 2A-2G, cols. 3-7) discloses a transistor structure having reduced transistor leakage attributes, comprising:

a substrate (10) having a surface, a corner region and at least one trench wall (26A, 26B);

a dopant in the corner region (fig. 2G);

a third layer forming a plug in a shallow trench isolation of the substrate; and

a transistor on the substrate (col. 7, lines 43-47).

Furukawa et al. fails to disclose the corner region having a rounded contour. However, Parekh et al. discloses that the corner region (31a, 31b) having a rounded contour (see fig. 3, col. 7, lines 1-19). Therefore, it would have been obvious to one having skill in the art at the time the invention was made to have the substrate having a rounded corner as taught by Parekh et al. into the device of Furukawa et al. in order to prevent leakage current and to provide better filling material in the trench while reducing the critical dimension for the trench width.

18. Claim 58-62, 64-76, as best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. [U.S. Pat. 5,798,553] in view of Salling et al. [U.S. Pat. 6,515,889].

Furukawa et al. (figs. 2A-2G, cols. 3-7) discloses a shallow trench isolation having reduced transistor leakage attributes, comprising:

- a substrate (10) having a surface, a corner region and at least one trench wall (26A, 26B);

- a dopant in the corner region (fig. 2G);

- a central area underneath the transistor having a threshold voltage that is about substantially uniform (fig. 2G);

- a third layer forming a plug in the shallow trench isolation of the substrate; and

- a transistor on the substrate (col. 7, lines 43-47).

Furukawa et al. does not disclose that the shallow trench isolation is used in an electronic system. However, Salling et al. discloses that the shallow trench isolation

(105) is used in the electronic system (fig. 10, col. 11, lines 56-61). Therefore, it would have been obvious to one having skilled in the art at the time the invention was made to use the shallow trench isolation in the electronic system as taught by Salling et al. in order to prevent leakage current entering the active device.

19. Claims 63 and 77 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. [U.S. Pat. 5,798,553] and Salling et al. [U.S. Pat. 6,515,889] as applied to claims 58-62, 64-76 above, and further in view of Parekh et al. [U.S. Pat. 5,945,724].

Furukawa et al. discloses all the limitation as claimed above except: the corner region having a rounded contour. However, Parekh et al. discloses that the corner region (31a, 31b) having a rounded contour (see fig. 3, col. 7, lines 1-19). Therefore, it would have been obvious to one having skill in the art at the time the invention was made to have the substrate having a rounded corner as taught by Parekh et al. into the device of Furukawa et al. in order to prevent leakage current and to provide better filling material in the trench while reducing the critical dimension for the trench width.

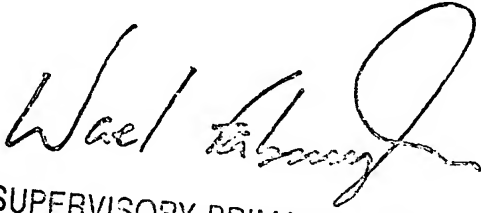
Conclusion

20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hoai V Pham whose telephone number is 703-308-6173. The examiner can normally be reached on 6:30A.M. - 6:00P.M..

21. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on 703-308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

22. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

HP
Hoai Pham
May 2, 2003


SUPERVISORY PRIMARY EXAMINER
TECHNOLOGY CENTER 2000